Estimating Cost Savings of Innovative Technologies

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http://www.lanl.gov/tsa/tsa4/enviro/etcap.html

Los Alamos

ESTIMATING COMPLEX-WIDE SAVINGS:

OBJECTIVES:

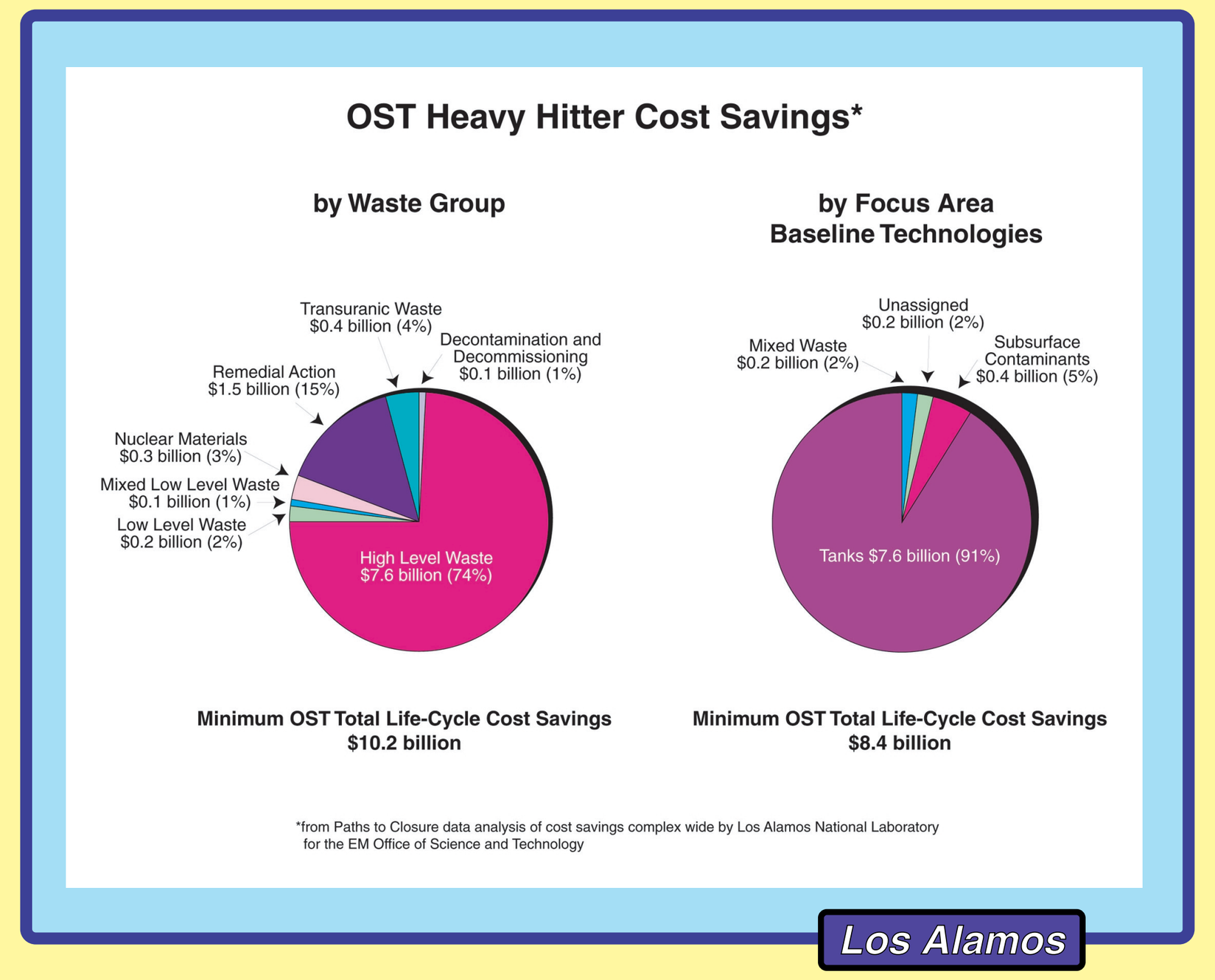
- Unbiased economic analyses of specific environmental technologies that are proposed for use within the DOE complex
- Support the U.S. Department of Energy's Office of Science and Technology (OST) in their efforts to evaluate environmental technologies to accelerate cleanup, reduce risk, increase efficiency, and track costs of remediation activities

METHODOLOGY:

- Identify new and baseline technologies
- Define system and scenarios
- Characterize performance of technologies
- Develop life-cycle cost of technologies
- Evaluate cost effectiveness
- Estimate potential cost savings for applicable sites

1998:

- DOE-Developed Environmental Technologies: An Analysis of Cost Savings Complex Wide, October 1998, Mark Cummings, Scott DeMuth, Janet Harry, Andy McCown, Bruce Mutter, and Ed Van Eeckhout, Los Alamos LA-UR-98-5517, 39 pp.
- Reviewed cost data reported by RL, INEEL, SRS, RFETS (the heavy hitter sites) resulting in 98 reported potential cost savings of $11B to $20B



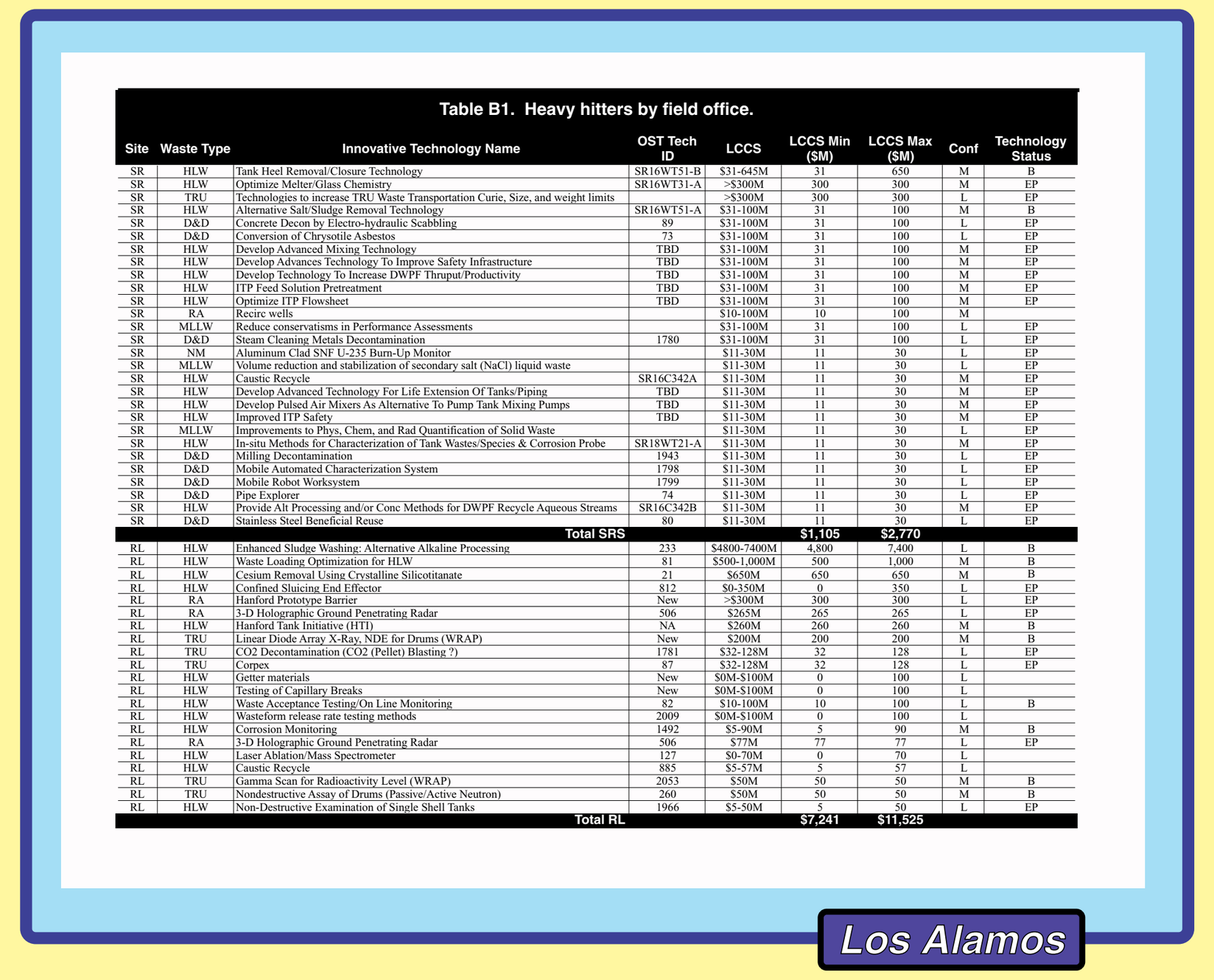


Table B1. Heavy hitters by field office.

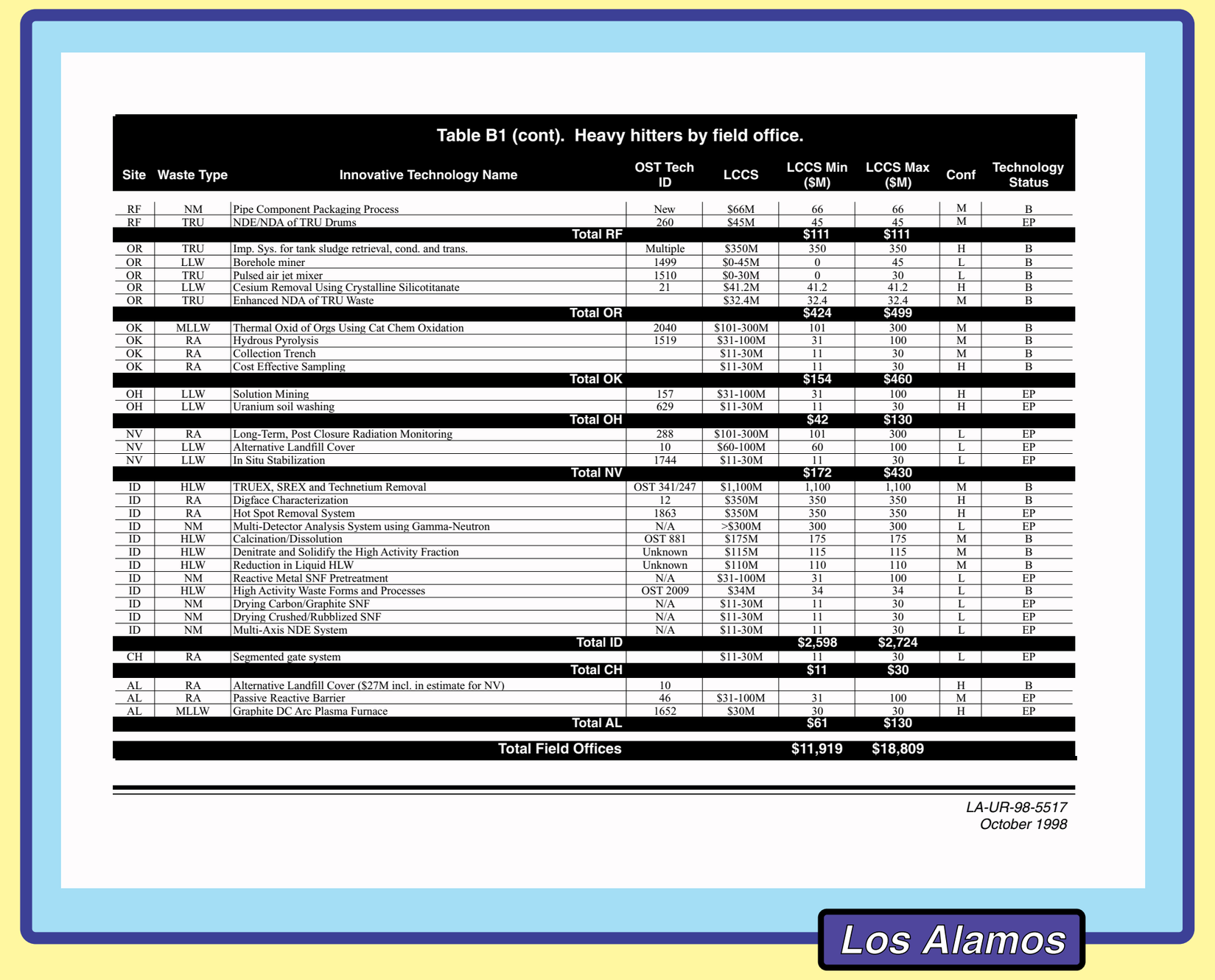
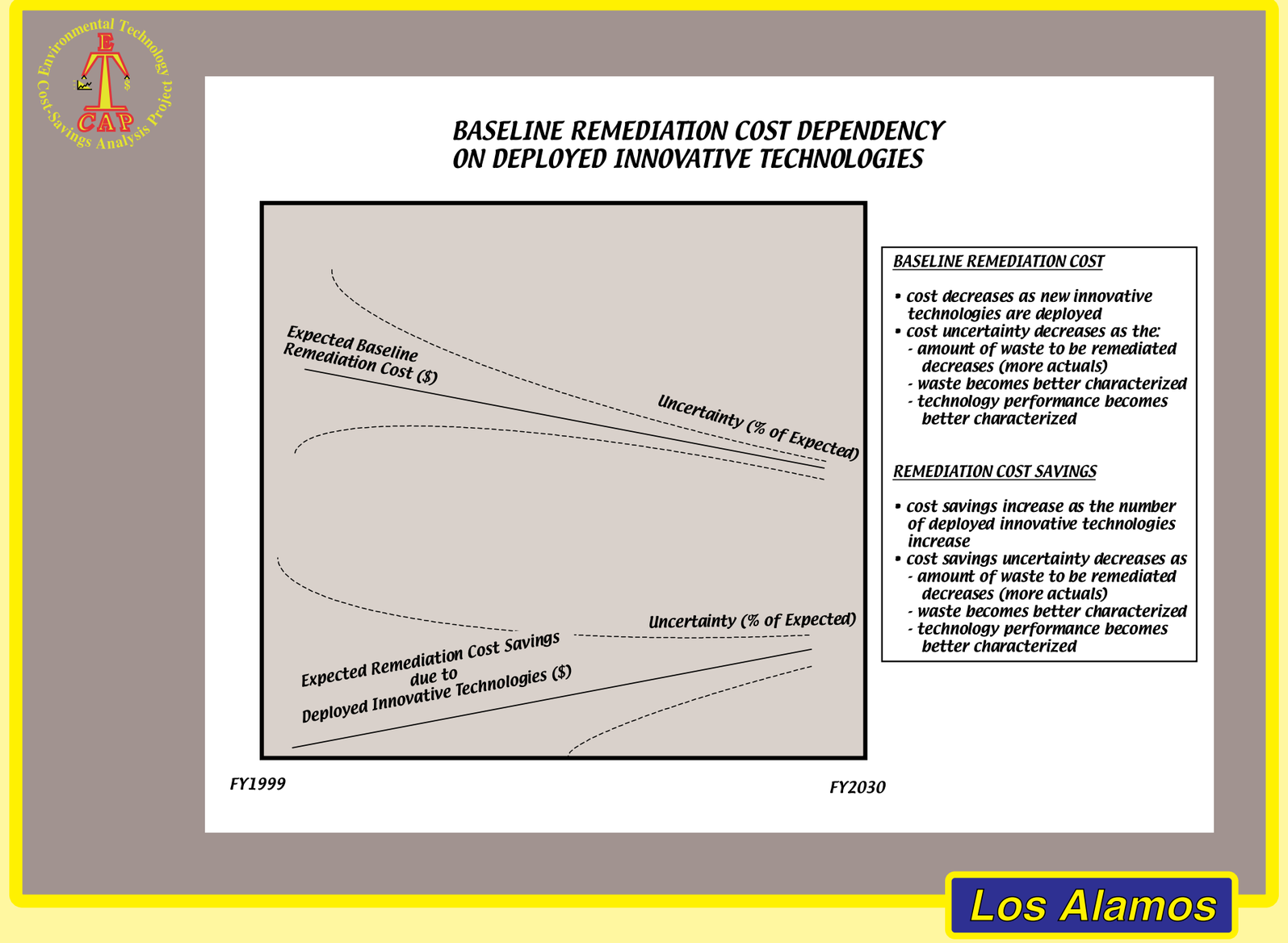


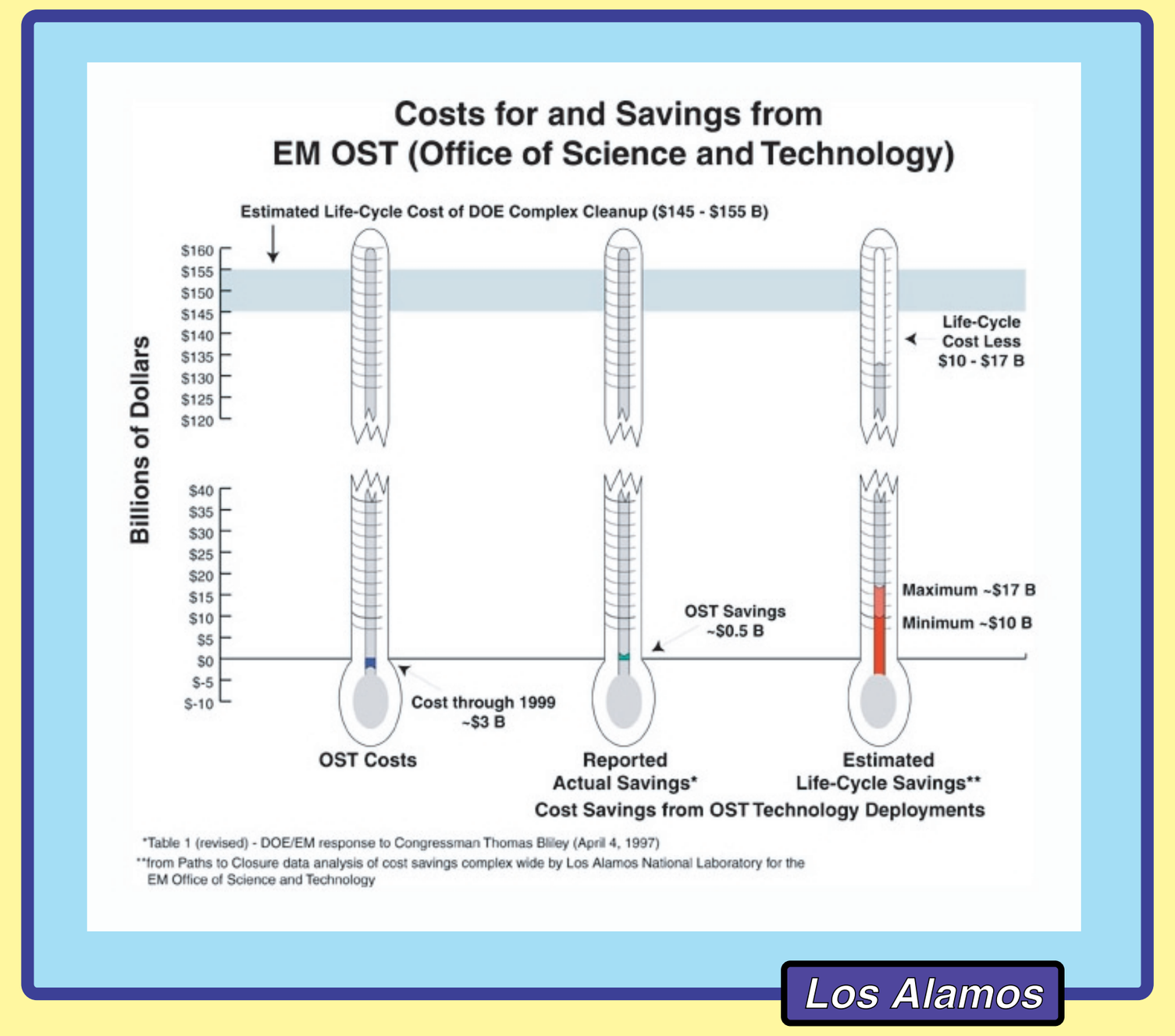
Table B1 (cont). Heavy hitters by field office.

1999-2000:

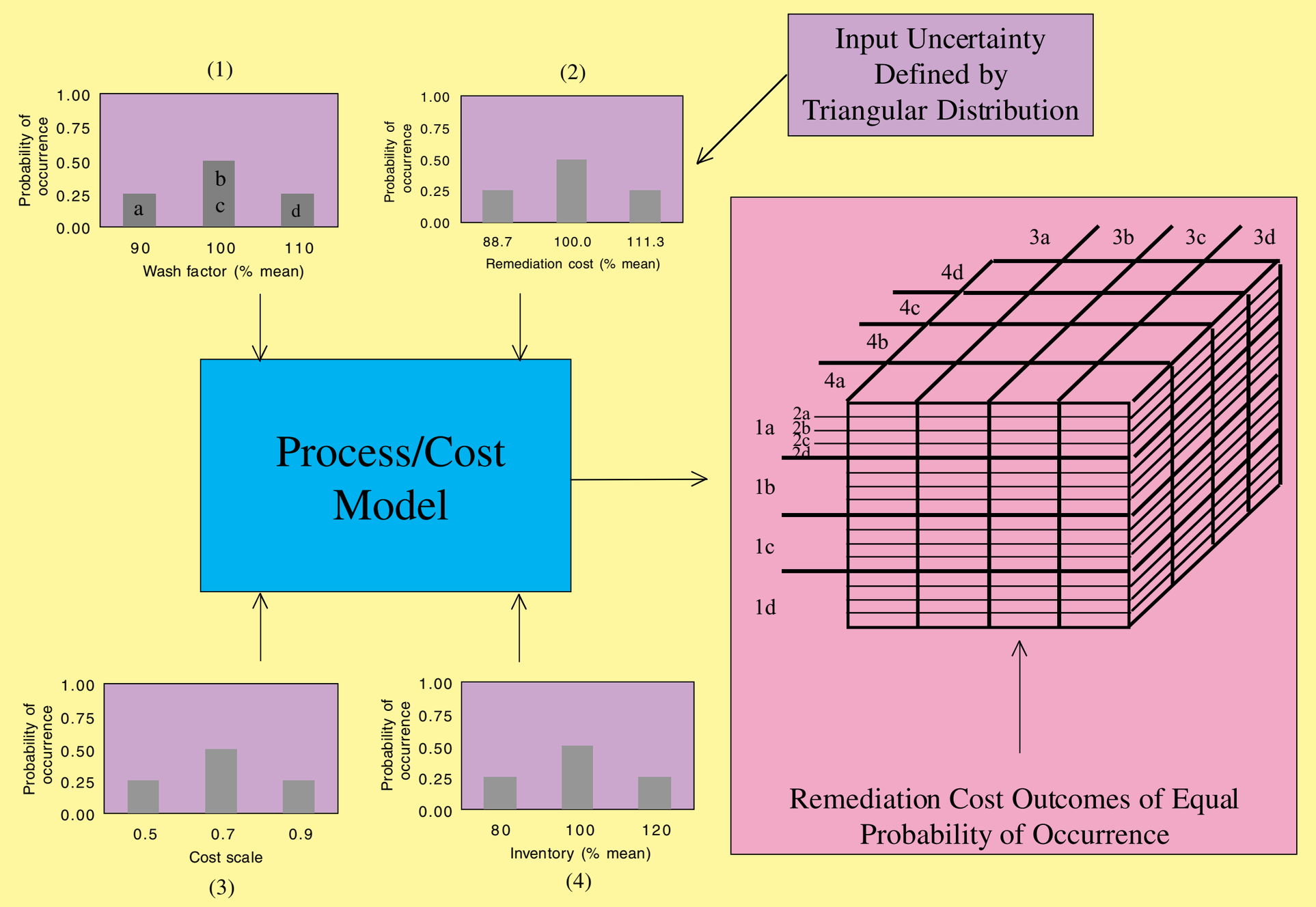
- Currently comparing 1998 cost savings with 1999 information reported in IDMS
- Working with sites to validate technology information and determining cost methods used
- Some data fields and definitions have changed from FY98 as a result of the new IDMS, making comparisons between 98 and 99 data somewhat difficult

TRENDS IN THE RESULTS TO-DATE:

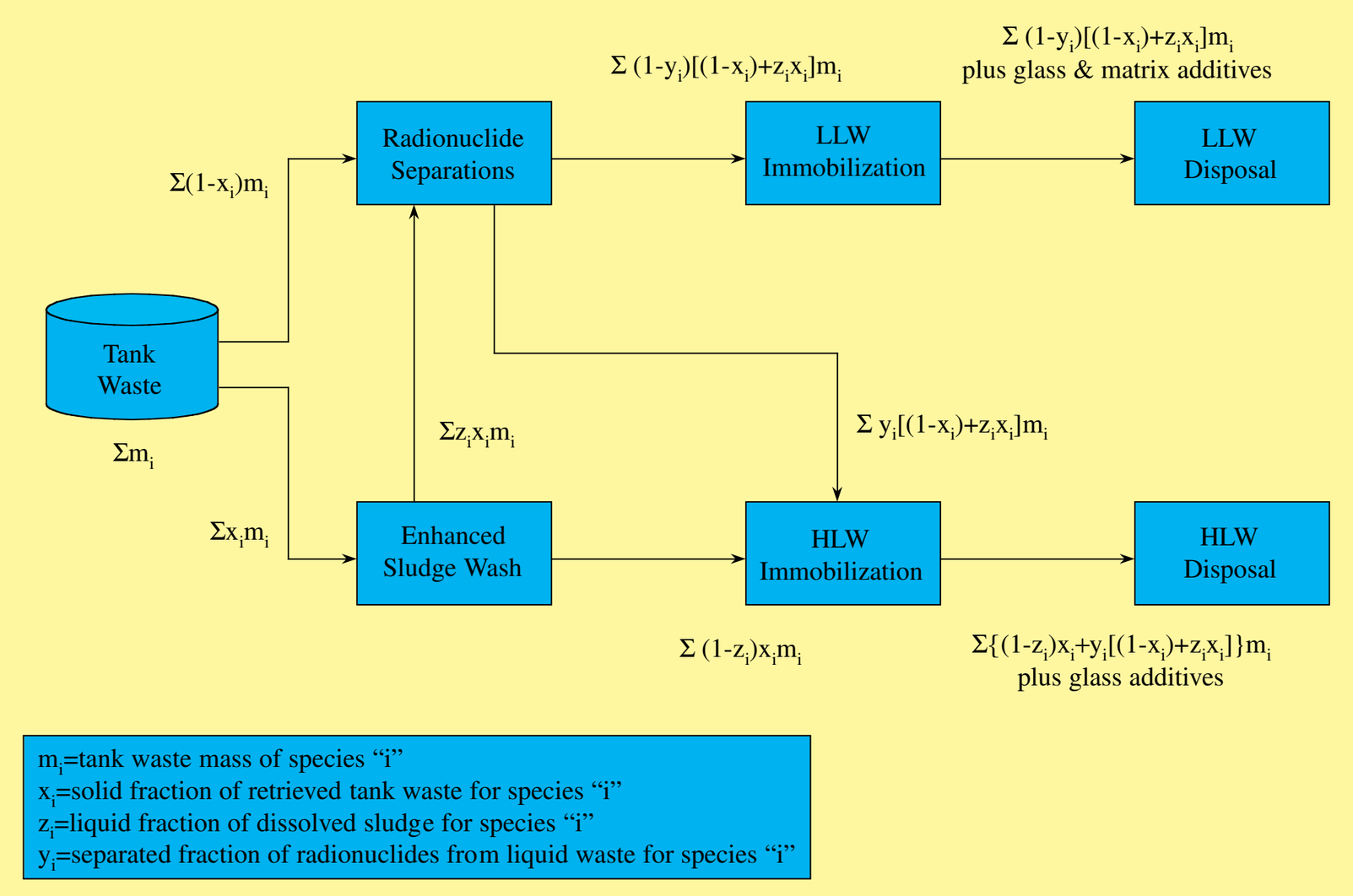




AN EXAMPLE: SLUDGE WASHING COST SAVINGS FOR TANKS



the process model:



m_i=tank waste mass of species "i"
x_i=solid fraction of retrieved tank waste for species "i"
z_i=liquid fraction of dissolved sludge for species "i"
y_i=separated fraction of radionuclides from liquid waste for species "i"

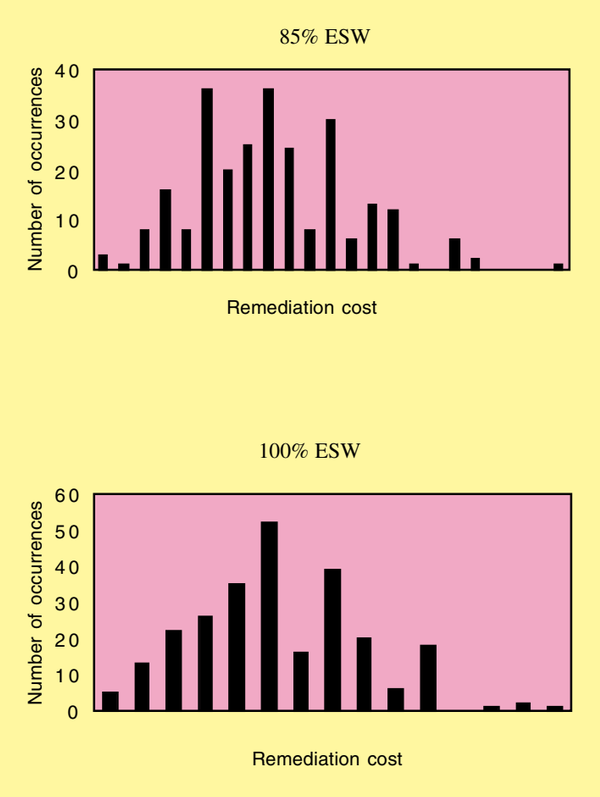
the cost model:

Table F-36 ($M) 1995 - $ Unit Operation	Construction	Labor	Equipment	M&S startup	M&S D&D	M&S operations	LLW vaults	HLW canisters	R&D	HLW repository	Total
Sludge Wash	43	129	6	2	12	6			9		207
IX	380	276	57	21	105	56			83		978
Centralized facilities	520										520
LLW immobilization	1300	624	179	68	332	176			264		2943
LLW disposal		16	9	4	17	9	225		14		294
HLW immobilization	1400	639	70	78	384	126			260		2957
HLW transportation		31									31
HLW disposal								239		5619	5858
Total	3643	1715	321	173	850	373	225	239	630	5619	13788

$ - Year	Discount rate (%)	Correction factor
1998	3.5	1.109

TWRS Cost Basis	Capital($M)	Operating($M)	R&D($M)	Total($M)	TWRS flowsheet Table 2-2 (Kg)		This flowsheet (hr-retrieved) or (Kg)	This flowsheet/TWRS flowsheet Operating cost fraction	Operating Cost "additional" ($M)	Operating Cost ($M)	Capital cost Scaling factor	Capital cost fraction	Capital Cost "additional" ($M)	Capital Cost ($M)	This flowsheet costs ($M)
Retrieve	5654	4102	0	9757	19804	tank waste			0.00		1.00		0.00		
Sludge Wash	77	143	10	220	1.97E+07	solid feed			0.00		1.00		0.00		
IX	878	306	92	1184	6.41E+08	liquid feed			0.00		1.00		0.00		
LLW immobilization	2471	692	293	3162	4.30E+08	glass product			0.00		1.00		0.00		
LLW disposal	293	18	16	310	4.30E+08	glass product			0.00		1.00		0.00		
HLW immobilization	2474	708	288	3182	2.41E+07	glass product			0.00		1.00		0.00		
HLW disposal	6495	34	0	6529	2.41E+07	glass product			0.00		1.00		0.00		
Total	12687	1901	698	24345											

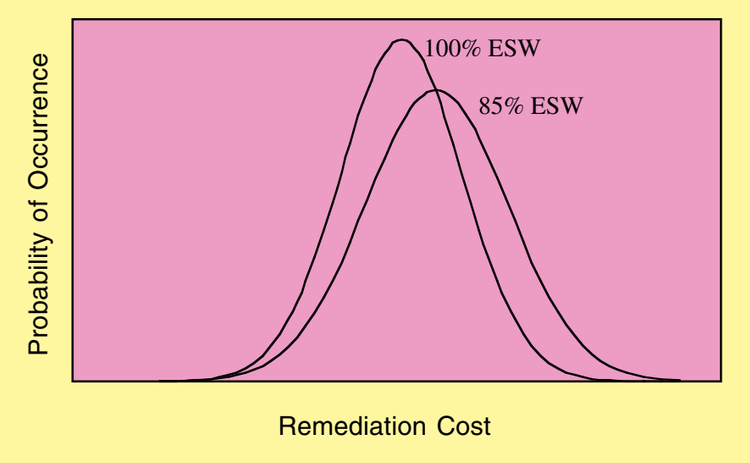
Remediation cost outcomes distributed discretely:



Remediation cost outcomes distributed continuously:

Normal Distribution

$$P(C_i) = \frac{e^{\left[\frac{1}{2}\left(\frac{C_i - \bar{C}}{\sigma}\right)\right]^2}}{\sqrt{2\Pi}\sigma}$$



Present Value of Cost Savings is $4.8B +/- 0.7B within 95% Confidence:

The Uncertainty for the Difference between Remediation Cost Distributions, or in other words the ESW Cost Savings, can be calculated at the 95% Confidence Interval by the Student-t's Distribution.

$$95\% = 2\sigma_p\sqrt{\left(\frac{1}{m^n_{ESW}} + \frac{1}{m^n_{SW}}\right)}$$

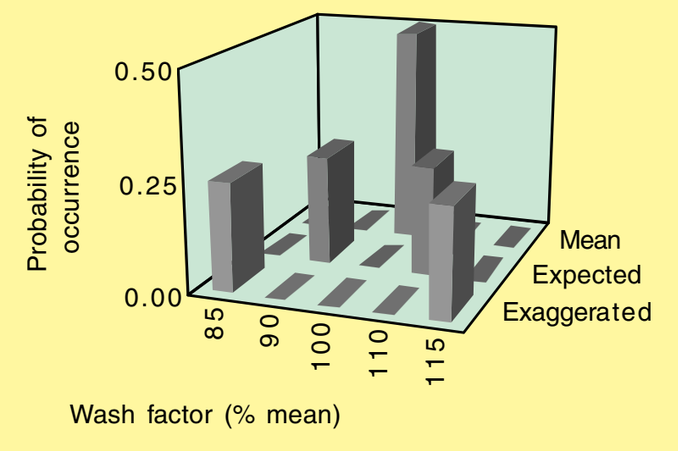
where

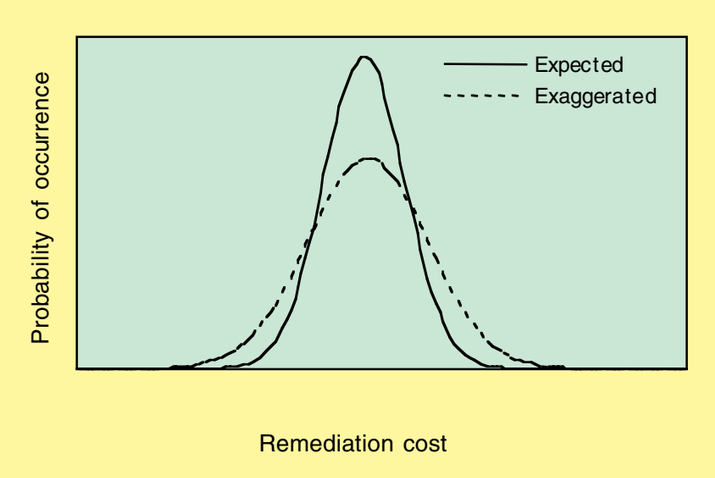
$$\sigma_p^2 = \frac{(m^n_{ESW}-1)\sigma^2_{ESW} + (m^n_{SW}-1)\sigma^2_{SW}}{(m^n_{ESW}+m^n_{SW}-2)}$$

m = # of occurrences
n = # of effects
σ = standard deviation
ESW = 100% ESW
SW = 75% ESW

Sensitivity analysis:

Cost Savings:





A sensitivity analysis indicated increasing the best-guess process and unit operation cost uncertainties by 50%, increases the overall cost savings uncertainty from $0.7 B to $1.9 B at 95% confidence.

Rate of Return:

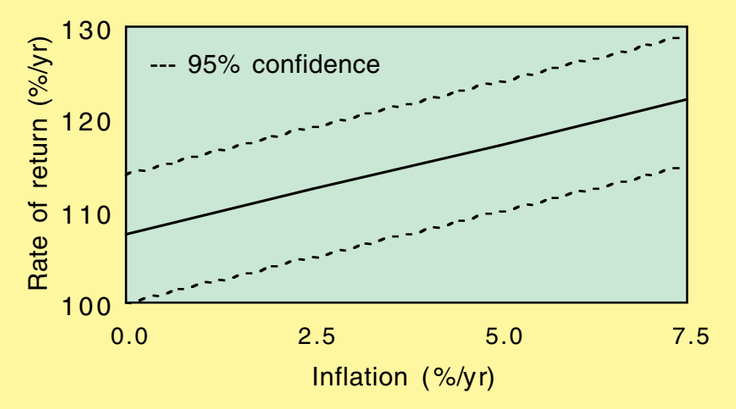
ROR for ESW based on:
(1) development costs
(2) ESW remedation cost savings distributed in time proportional to TWRS EIS schedule for capital and operating costs

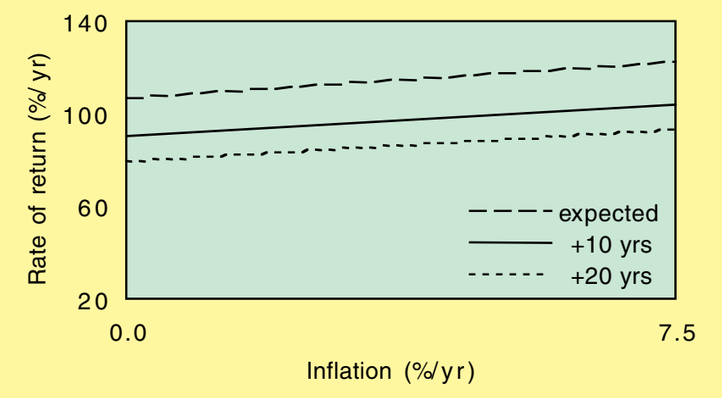
$$\frac{(-1.050)}{(1+I)^{(1993-1995)}} + \frac{(-1.400)}{(1+I)^{(1994-1995)}} + (-10.407) + \frac{(-2.782)}{(1+I)^{(1996-1995)}} +$$

$$\frac{(-4.556)}{(1+I)^{(1997-1995)}} + \frac{\left[84(1+K)^{(1998-1995)} - 4.495\right]}{(1+I)^{(1998-1995)}} + \ldots + \frac{121(1+K)^{(2022-1995)}}{(1+I)^{(2022-1995)}} = 0$$

$$\sum_{j=0}^{n}\left[\frac{CF_j}{(1+I)^j}\right] = 0$$

I = rate of return
CF = cash flow in actual dollars in jth year





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Office of Science and Technology — Tanks Focus Area

TSA-4 Energy and Environmental Analysis — Environmental Assessment